

REMARKS/ARGUMENTS

The amendments to Claims 1, 4, 5, 8, 14, 15 and 16 comprise editorial changes to recite the invention described on Page 2, Lines 8-20 of the specification. The amendments do not constitute new matter.

35 U.S.C. 112, first paragraph

Claims 3, 4, 7, 8 and 14 stand rejected under 35 U.S.C. 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention.

The above rejection is rendered moot by the cancellation of Claims 3 and 7 and by the amendments of Claims 4, 8 and 14. Amended Claims 4, 8 and 14 now depend from a claim which does not recite the limitation relating to TEM.

35 U.S.C. 103(a)

Page 2, Second Paragraph of the Second Advisory Action states:

- (1) "...The science involved in the instant invention and the teaching of Suss et al is basically the same."
- (2) "Thus said clay is intercalated with the organic cation and the said intercalated organic cation forms a complex with organic anion which is present at around the edge of the clay." (Underlining added for emphasis.)

Applicants respectfully disagree with the above statements for the following reasons.

- (1) The science involved in the invention recited in Claims 1, 2, 4, 5, 6, and 8-19 and the teaching of Suss et al. (US Patent 4,558,075) are NOT basically the same. The key feature of the present invention is the elimination or reduction of any attractions between clay particles or stacks through edge to edge and edge to surface interactions. This is done by coating the edges of a multilayered silicate material with a polyvalent anionic polymer. This is the first and critical step to achieve superior clay dispersion in the final product. The functional groups on the polyvalent anionic

polymer interact with the edge of clay particles, providing a few anchors for the polyvalent anionic polymer to stick on the edge of clay particles. The hydrophobic portion of the polyvalent anionic polymer covers the polar nature of $Mg(OH)_x$ and $Al(OH)_x$ on the edge of the clay particles to prevent or minimize the interactions between clay particles or stacks.

(2) Suss et al. teach at col. 12, lines 31-44:

“The organophilic, organo-modified clays suitable for use in the high-solids coating composition of the present invention may be prepared by admixing the organic anion with a clay and water together, preferably at a temperature between 20 °C. and 100 °C for a sufficient time to prepare a homogenous mixture followed by the addition of the organic cation in sufficient amounts to satisfy the cation exchange capacity of the clay and the cationic capacity of the organic anion. The mixture is reached [sic] with agitation at a temperature between 20 °C. and 100 °C. for a sufficient time to allow the formation of an organic cation-organic anion complex which is intercalated with the clay and the cation exchange sites of the clay are substituted with the organic cation.”

Contrary to the statement in the Office Action, the above description does not teach the clay as being intercalated with the organic cation and the intercalated organic cation forming a complex with organic anion which is present at around the edge of the clay. Rather, the above description teaches (1) forming a homogeneous mixture of the organic anion, clay and water and then (2) adding an organic cation to the homogeneous mixture to form an organic cation-organic anion complex. The organic cation-organic anion complex is then intercalated with the clay and the cation exchange sites of the clay are substituted with the organic cation. The above description does not mention anything about an organic anion which is present at around the edge of the clay. There is always some free cations in the solution mixture that will interact with the anion before the anion has a chance to see clay edges. In addition, the interactions between organic cation and exchangeable site on clay surface is reversible. If there is anion available, the organic cation can come off from the clay surface to interact with the anion. Therefore, the clay edge will not be able to compete effectively with the cation for the anion.

In addition, it is known that organic compounds presented in the anionic form are usually repelled by, rather than attracted to, the negatively charged clay surface. (Underlinings added for emphasis.) See, for example, U.S. Patent 4, 412,018, column 1, lines 29-31 and U.S. Patent 4,434,075, column 1, lines 28-30. U.S. Patent 4,412,018 is incorporated by reference by Suss et al. in Column 8, line 13.

In view of the above remarks, Applicants submit that, contrary to the statement in the Office Action, the organic anion is not present at around the edge of the clay.

Suss describes in column 1 the problem of sagging of high-solids thermosetting composition. Suss solves this problem by increasing the interactions between clay to clay particles. Suss teaching is the complete opposite of the present invention. The main objective of Suss is to alleviate the problem of sagging of high solids thermosetting compositions (col. 1, lines 15-55). The purpose of the binder is to increase the low shear viscosity of the solution mixture through clay to clay interactions which will prevent paint dripping after applying the paint to a substrate. The binder bridges the gaps between clay particles. On the other hand, the object of the present invention is to reduce or eliminate "clay to clay" interactions.

In view of the above remarks, and the remarks in Applicants' Reply to the First Advisory Action relating to WO 93/04117, Christianni et al (US 5,747,560), Kawasumi et al. (US 4,810,734) and Polansky et al. (US 6,287,992), Applicants submit that Claims 1, 2, 4, 5, 6, and 8-15 are patentable under 35 U.S.C. 103(a) over WO 93/04117 or Christianni et al (US 5,747,560) in view of Suss et al. (US 4,558,075) and that Claims 16-19 are patentable under 35 U.S.C. 103(a) over Kawasumi et al. (US 4,810,734) or Polansky et al. (US 6,287,992) in view of Suss et al. (US 4,558,075).

Conclusion

In view of the above amendments and remarks, the claims are now in condition for allowance and a Notice of Allowance of Claims 1, 2, 4, 5, 6, and 8 to 19 is respectfully requested.

Respectfully submitted,



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COMPLETE LISTING OF CLAIMS

1. (Currently Amended) ~~A process for producing a nanocomposite polymer by dispersing a multi-layered silicate material into a thermoplastic polymer, comprising the steps of (a) coating the edges of a mixing a quaternary ammonium intercalated multi-layered silicate material with a polyvalent anionic organic material so that the edges of the multi-layered silicate material are bound to the polyvalent anionic organic material, (b) intercalating the polyvalent anionic organic edge-coated multilayered silicate material with quaternary ammonium to form a polyvalent anionic organic edge-coated quaternary ammonium intercalated multilayer silicate material, and (3) mixing the polyvalent anionic polymer edge-coated quaternary ammonium intercalated multilayer silicate material with the thermoplastic polymer at a temperature greater than the melting or softening point of the thermoplastic polymer, characterized by the quaternary ammonium intercalated multi-layered silicate material having been reacted with a polyvalent anionic organic material so that the edges of the multi-layered silicate material are bound to the polyvalent anionic organic material to form a polyvalent anionic organic edge coated quaternary ammonium intercalated multi-layered silicate material.~~

2. (Original) The process of Claim 1, wherein the thermoplastic polymer is selected from the group consisting of a thermoplastic urethane, a thermoplastic epoxy, a thermoplastic polyester, a thermoplastic nylon, a thermoplastic polycarbonate; and blends thereof.

3. (Canceled)

4. (Currently Amended) ~~The process of Claim 1 or Claim 3~~Claim 2, wherein the thermoplastic polymer is a blend of thermoplastic polymers.

5. (Currently Amended) A process for producing a nanocomposite polymer by dispersing a multi-layered silicate material into a thermoset polymer, comprising the steps of: (1) coating the edges of a multi-layered silicate material with a polyvalent anionic organic material so that the edges of the multi-layered silicate material are bound to the polyvalent anionic organic material, (2) intercalating the polyvalent anionic organic edge-coated multilayered silicate material with quaternary ammonium to form a polyvalent anionic organic edge-coated quaternary ammonium intercalated multilayer silicate material, and (3) mixing the polyvalent anionic organic edge-coated quaternary ammonium intercalated multilayer silicate material with the thermoset prepolymer and (3) curing the thermoset prepolymer to form the thermoset polymer.

~~-(a) mixing a quaternary ammonium intercalated multi-layered silicate material with a thermoset prepolymer, characterized by the quaternary ammonium intercalated multi-layered silicate material having been reacted with a polyvalent anionic organic material so that the edges of the multi-layered silicate material are bound to the~~

~~polyvalent anionic organic material to form a polyvalent anionic organic edge-coated quaternary ammonium intercalated multi-layered silicate material;~~

~~(b) curing the thermoset prepolymer to set the thermoset polymer.~~

6. (Original) The process of Claim 5, wherein the thermoset polymer is selected from the group consisting of a thermoset epoxy, a thermoset phenolic, a thermoset urethane, a thermoset rubber and blends thereof.

7. (Canceled)

8. (Currently Amended.) The process of Claim 7~~5~~, wherein the thermoset polymer is a blend of thermoset polymers.

9. (Original) The process of Claim 1, wherein the thermoplastic polymer is selected from the group consisting of polypropylene, polyethylene, polystyrene, polystyrene copolymers, acrylic polymers, acetyl polymers and thermoplastic elastomers and blends thereof.

10. (Original) A composition comprising:

(a) a polymer; and

(b) a multi-layered silicate material dispersed in the polymer, the multi-layered silicate material having edges, characterized by at least a portion of the edges of the multi-layered silicate material being bound to a polyvalent anionic organic material.

11. (Original) The composition of Claim 10, wherein at least about one half of the edges of the multi-layered silicate material are bound to the polyvalent anionic organic material.

12. (Original) The composition of Claim 10, wherein the polymer is selected from the group of thermoplastic polymers and thermoset polymers and blends thereof.

13. (Original) The composition of Claim 12, wherein the thermoplastic polymers and thermoset polymers are selected from the group consisting of a thermoplastic urethane, a thermoplastic epoxy, a thermoplastic polyester, a thermoplastic nylon, a thermoplastic polycarbonate, polypropylene, polyethylene, polystyrene, polystyrene copolymers, acrylic polymers, acetyl polymers, thermoplastic elastomers, thermoset epoxy, a thermoset phenolic, a thermoset urethane, a thermoset rubber and blends thereof.

14. (Currently Amended) The process of Claims ~~1-9~~ 4, wherein the polyvalent anionic organic material is a polyacrylate.

15. (Currently Amended) The composition of Claims ~~10-13~~, wherein the polyvalent anionic organic material is a polyacrylate.

16. (Currently Amended) A process for producing a nanocomposite polymer, comprising the steps of:

(a) coating the edges of a multi-layered silicate material with a polyvalent

anionic organic material so that the edges of the multi-layered silicate material are bound to the polyvalent anionic organic material. (b) intercalating the polyvalent anionic organic edge-coated multilayered silicate material with quaternary ammonium to form a polyvalent anionic polymer edge-coated quaternary ammonium intercalated multilayer silicate material. and (c) mixing the polyvalent anionic polymer edge-coated quaternary ammonium intercalated multilayer silicate material with a monomer; mixing a quaternary ammonium intercalated multi-layered silicate material with a monomer, characterized by the quaternary ammonium intercalated multi-layered silicate material having been reacted with a polyvalent anionic organic material so that the edges of the multi-layered silicate material are bound to the polyvalent anionic organic material to form a polyvalent anionic organic edge coated quaternary ammonium intercalated multi-layered silicate material; and

(b) polymerizing the monomer.

17. (Original) The process of Claim 16, wherein the monomer is a blend of monomers.

18. (Original) The process of Claim 16, wherein the polymer is selected from the group consisting of a thermoplastic urethane, a thermoplastic epoxy, a thermoplastic polyester, a thermoplastic nylon, a thermoplastic polycarbonate, polypropylene, polyethylene, polystyrene, polystyrene copolymers, acrylic polymers, acetyl polymers, thermoplastic elastomers,

19. (Original) The process of Claim 18, wherein the polyvalent anionic organic is a polyacrylate.